

Claims:

5 1. A method for performing link adaptation in a communication system,
in which two communication devices are arranged to communicate with
in order to transfer information at least partly wirelessly, packets are
formed from the information to be transferred, the packet error rate is
determined, and for which connection at least two different modulation
10 modes can be selected, **wherein** the method uses fuzzy control in the
selection of the modulation mode, and that at least one of the variables
used in fuzzy control is said defined packet error rate.

15 2. The method according to claim 1, **wherein** in the method a target
value is determined to the packet error rate, that the packet error rate is
aimed to be kept substantially the same as the target value, and that
the difference between the packet error rate and the target value is
also used as a variable in the method.

20 3. The method according to claim 2, **wherein** for performing fuzzy
control a first set of control values is formed, in which the packet error
rate is used as a variable, a second set of control values is formed, in
which the change rate of the packet error rate is used as a variable,
and a set of fuzzy rules is arranged, which are used for determining the
25 effect of the control values to the modulation mode used as a
controllable value.

30 4. The method according to claim 3, **wherein** said control value sets
are formed of the values: positive large, positive medium, positive
small, negligible, not small, not medium, and not large.

5. The method according to claim 4, **wherein** said set of fuzzy rules is
determined on the basis of the following table:

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PERdt	PER							
		NL	NM	NS	Z	PS	PM	PL
	NL	P_6	P_5	P_4	P_3	P_2	P_1	N
	NM	P_5	P_4	P_3	P_2	P_1	N	N_1
	NS	P_4	P_3	P_2	P_1	N	N_1	N_2
	Z	P_3	P_2	P_1	N	N_1	N_2	N_3
	PS	P_2	P_1	N	N_1	N_2	N_3	N_4
	PM	P_1	N	N_1	N_2	N_3	N_4	N_5
	PL	N	N_1	N_2	N_3	N_4	N_5	N_6

6. The method according to claim 5, **wherein** said first set of control values comprised the following values:

PER	NL	NM	NS	Z	PS	PM	PL
$\mu=1$	0.07	0.08	0.09	0.10	0.11	0.12	0.13

that said second set of control values comprises the following values:

PERdt	NL	NM	NS	Z	PS	PM	PL
$\mu=1$	-0.006	-0.004	-0.002	0	0.002	0.004	0.006

and that said set of fuzzy controls comprises the following values:

N_6	N_5	N_4	N_3	N_2	N_1	N	P_1	P_2	P_3	P_4	P_5	P_6
-1.2	-1.0	-0.8	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8	1.0	1.2

7. The method according to claim 6, **wherein** in the method a set of modulation modes is defined, wherein for each modulation mode an individualizing index is defined, and in the method at least the following steps are taken:

- an initialisation phase, wherein one of said indexes is selected in order to select the modulation mode used in the communication connection,

- a computing phase, in which the difference of the packet error rate from the target value, and the change rate of the packet error rate are calculated, and
- a fuzzy control phase, in which fuzzy control is used for defining the index change of the modulation mode, wherein the modulation mode according to the calculated new index is selected for the communication connection.

8. The method according to claim 7, **wherein** said calculating phase and the fuzzy control phase are repeated.

9. The method according to claim 1, **wherein** the transmission power is also controlled in the method.

10. The method according to claim 9, **wherein** in the method the modulation mode is adjusted until a such modulation mode is obtained, by which the packet error rate (PER) is substantially the same as said target value of the packet error rate, whereafter the transmission power is adjusted by using fuzzy control.

11. The method according to claim 9, **wherein** the modulation method and the transmission power are selected substantially simultaneously.

12. A communication system, comprising means for arranging two communication devices to communicate with each other in order to transfer packet-form information at least partly wirelessly, means for determining a packet error rate, and means for selecting for the connection a modulation mode from at least two modulation modes, **wherein** the communication system comprises means for using fuzzy control in the selection of the modulation mode, and that at least one variable arranged to be used in fuzzy control is the packet error rate.

13. The communication system according to claim 12, **wherein** a target value is defined for the packet error rate, that the means for the link adaptation comprise means for adjusting the packet error rate to substantially the same as said target value, and that the difference

between the packet error rate and the result value is additionally arranged to be used as a fuzzy control variable.

14. The communication system according to claim 13, **wherein** for performing fuzzy control a first set of control values is formed, in which the packet error rate has been used as a variable, and a second set of control values, in which the change rate of the packet error rate has been used as a variable, and that a set of fuzzy rules has been formed for defining the influence of the control values of said variables to the modulation mode used as a controllable value.

15. An access point controller comprising means for arranging the access point controller and at least one wireless terminal to communicate with each other in order to transmit packet-form information at least partly in a wireless manner, means for defining the packet error rate, and means for selecting for the connection a modulation mode from at least two modulation modes, **wherein** the access point controller comprises means for using fuzzy control in the selection of the modulation mode, and that in fuzzy control at least one variable that is arranged to be used is said defined packet error rate.

16. A wireless terminal, comprising means for transmitting packet-form information at least partly wirelessly in a communication connection arranged between the wireless terminal and a second communication device, means for defining the packet error rate, and means for selecting for the connection a modulation mode from at least two modulation modes, **wherein** the wireless terminal comprises means for using fuzzy control in the selection of the modulation mode, and that in fuzzy control at least one variable that is arranged to be used is said defined packet error rate.